

SPECIES OF THE GENUS *ZEROS* CRESSON (DIPTERA: EPHYDRIDAE)
FROM CHINA

JINJUA ZHANG, DING YANG, AND WAYNE N. MATHIS

(JZ, DY) Department of Entomology, China Agricultural University, Beijing 100094, China (e-mail: dyangcau@yahoo.com.cn); (WNM) Department of Entomology, National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, MRC 169, Washington, DC 20013-7012, U.S.A. (e-mail: mathisw@si.edu)

Abstract.—The genus *Zeros* Cresson is recorded from China for the first time. The two species, *Z. maculosus*, n. sp., and *Z. orientalis* Miyagi, are described, and a key to distinguish them is presented.

Key Words: Diptera, Ephydridae, *Zeros*, new species, China

The shore-fly genus *Zeros* Cresson, 1943, is currently placed in the tribe Ilytheini, subfamily Ilytheinae. The genus occurs worldwide in temperate and tropical zones, and thus far 11 species have been described (Mathis and Zatwarnicki 1995). Two species are known from the Palearctic Region (Cogan 1984) and three species have been recorded from the Oriental Region (Cogan and Wirth 1977, Mathis and Zatwarnicki 1995). Herein the genus is recorded from China for the first time and is represented by two species, which are revised. In addition to their descriptions and illustrations, we are providing locality data from China and elsewhere in the Oriental Region. A key to the two species occurring in China is presented to facilitate their identification.

METHODS AND MATERIALS

The descriptive terminology, with the exceptions noted in Mathis (1986) and Mathis and Zatwarnicki (1990a), follows McAlpine (1981). Because specimens are small, less than 2.50 mm in length, study and illustration of the male terminalia

requires use of a compound microscope. For most of the structures of the male terminalia, we follow the terminology that other workers in Ephydridae have used (see references in Mathis [1986] and Mathis and Zatwarnicki [1990a, 1990b]). The species' descriptions are composite and not based solely on holotypes.

Two venational indices used in the descriptions are defined below.

1. Costal vein ratio: the straight line distance between the apices of R_{2+3} and R_{4+5} (costal section III)/distance between the apices of R_1 and R_{2+3} (costal section II).
2. M vein index is the straight line distance along vein M between cross-veins dm-cu and r-m/distance apicad of dm-cu.

Most specimens examined as part of this study are deposited in the Entomological Museum of the China Agricultural University (CAU), Beijing, China, and the holotype of *Z. orientalis* Miyagi is deposited in the Entomological Institute, Hokkaido University, Sapporo, Japan (HUS). We also studied specimens

in the National Museum of Natural History, Smithsonian Institution, Washington, D. C. (USNM).

Tribe Ilytheini Cresson

Ilytheini Cresson 1943: 2. Type genus: *Ilythea* Haliday in Curtis 1837.—Cresson 1943: 1–16 [review].—Cogan and Wirth 1977: 336 [Oriental catalog].—Mathis and Zatwarnicki 1995: 186–190 [world catalog].—Hollmann-Schirmmacher 1998: 17–29 [review].

Diagnosis.—Ilytheini are distinguished from other tribes of the subfamily Ilytheinae by the following combination of characters (synapomorphies indicated by an asterisk): *Head*: Fronto-orbital setae conspicuous, well developed, mostly reclinate, proclinate, or both. *Thorax*: Acrostichal setae in 2 rows, some species with setae comparatively well developed; *posterior notopleural seta inserted much farther dorsad from notopleural suture than anterior seta; 1–2 intra-alar setae well developed; prescutellar acrostichal setae well developed. *Crossvein r-m aligned between humeral and subcostal costal breaks, distinctly basad of level of subcostal break. *Abdomen*: *Male terminalia with gonite greatly reduced. *Female sternites 4 and 5 bearing rows of setae; *female ventral receptacle with reduced operculum.

Remarks.—The tribe Ilytheini includes three genera: *Donaceus* Cresson, 1949, *Ilythea* Haliday, 1837 and *Zeros* Cresson, 1943 that can be distinguished using the following key.

KEY TO GENERA OF ILYTHEINI

- 1. Dorsocentral setae 3 (1+2) . . . *Donaceus* Cresson
- Dorsocentral setae 2 (1+1) 2
- 2. Vein R₂₊₃ long, subparallel to C; costal section II over twice as long as section III *Ilythea* Haliday
- Vein R₂₊₃ short, running almost straight to C; costal section II subequal to section III *Zeros* Cresson

Zeros Cresson, 1943

Zeros Cresson 1943: 10 [type species: *Ilythea obscura* Cresson, by original designation].—Cogan and Wirth 1977: 336 [Oriental catalog].—Mathis and Zatwarnicki 1995: 188–190 [world catalog].—Hollmann-Schirmmacher 1998: 24 [review].

Diagnosis.—*Zeros* is distinguished from other genera of the tribe Ilytheini by the following combination of characters: dorsocentral setae 2 (1+1); postsutural intra-alar setae 1; vein R₂₊₃ short, usually extended almost straight to C; length of costal section II subequal to that of section III; and 2 supra-alar setae (Hollmann-Schirmmacher 1998).

Description.—*Head*: Frons uniformly, slightly convex, with a longitudinal, medial sulcus between anterior of ocelli and ptilinal suture; mesofrons and parafrons separated by slight impression; vertex rather sharp; occiput concave. Antenna short, inserted well above center line of head and eye; arista pectinate with long, dorsal branches. Face large, moderately protuberant in lateral view; intrafoveal carina prominent, as a nose-like prominence with a rather distinct, sometimes denuded tubercle at level dividing sloping dorsal facial surfaces; facial setae mostly mesocline, long, and well developed, series sometimes extended ventrally in line with parafacials, dorsal seta somewhat dorsocline, setae ventrad becoming gradually more ventrocline. Eye large, nearly round. Genal seta well developed, inserted anteriorly. Mouth opening large, gaping; clypeus thin, frequently not exposed.

Thorax: Short, subglobose; scutum quadrate. Acrostichal setae 4–5, moderately well developed; dorsocentral setae 2 (1+1); postsutural intra-alar setae 1; basal scutellar seta inserted near base; postpronotum lacking setae; posterior notopleural seta inserted at elevated level from anterior seta; presutural supra-alar seta reduced or lacking; postsutural

supra-alar seta lacking; postsutural intra-alar seta 1, inserted posteriorly; anepisternal and katepisternal setae well developed. Wing usually hyaline to faintly infuscate with dark linear spots or bands, these sometimes partially connected, forming 2–3 irregular, transverse bands; vein R_{2+3} short, strongly divergent from vein R_{4+5} , making costal sections II and III more or less equal in length; last section of vein CuA_1 almost reaching posterior wing margin. Legs slender, not conspicuously setose.

Abdomen: Ovate to rotund; tergite 5 of male longer than 4; 5th sternite of male deeply U-shaped or divided as 2 lateral sclerites. Male terminalia generally reduced with fusion and/or loss of structures such as pre- and postsurstylus (presurstylus may be fused to ventral margin of epandrium), most of gonite (sometimes evident), a tubular, gently to strongly curved aedeagus, a reduced phallapodeme, and hypandrium narrow to wide, elongate.

Natural history.—Foote (2007) reported that the larvae of *Zeros* and *Ilythea* construct a case that probably gives protection by providing a camouflage covering against predators. The larvae feed on diatoms in wet, sandy or muddy habitats.

KEY TO SPECIES OF *ZEROS* FROM CHINA

1. Wing (Fig. 1) with many dark brown spots; vein R_{2+3} sinuous; epandrium (Fig. 2) slender dorsally, tapered toward base with several strong setae toward ventral end and around cercal cavity in posterior view; hypandrium (Fig. 5) with a triangular projection in lateral view . . . *Z. maculosus*, n. sp.
- Wing (Fig. 7) with few dark brown spots; veins straight; epandrium (Fig. 8) parallel-sided with 4 strong setae at ventral end in posterior view; hypandrium (Fig. 11) lacking projection in lateral view
 *Z. orientalis* Miyagi

Zeros maculosus Zhang, Yang, and Mathis, new species (Figs. 1–6)

Diagnosis.—Wing with many dark brown spots; veins near spots sinuous.

Epandrium tapered toward base in posterior view, with several strong setae at base; hypandrium with a projection in lateral view; aedeagus spoon-shaped in lateral view.

Description.—Male. Body length 2.05 mm, wing length 2.25 mm.

Head: Subshiny black; frons dull black, with brownish-yellow microtomentum. 2 vertical setae; 2 fronto-orbital setae, anterior fronto-orbital proclinate, posterior fronto-orbital reclinate, reclinate fronto-orbital stronger than proclinate fronto-orbital seta; 1 pair of strong ocellar setae. Face brownish yellow with silvery-white microtomentum, facial tubercle dark brown with brownish-yellow microtomentum; face with 4 strong setae on each side. Gena with 1 strong seta. Antenna brown with brownish-yellow microtomentum; pedicel with 2 dorsal setae; arista with 7 dorsal rays.

Thorax: Subshiny black; mesonotum, notopleuron, anepisternum, and katepisternum brownish-yellow microtomentose. 1 presutural supra-alar seta; 2 strong dorsocentral setae; 2 rows of small acrostichal setulae; 1 strong prescutellar seta; 2 notopleural setae; 2 strong supra-alar setae. Anepisternum covered with fine yellow setulae at upper portion, with 1 strong seta at posterior margin; katepisternum with 1 strong seta. Scutellum black with brownish-yellow microtomentum, with 2 pairs of scutellar setae. Wing (Fig. 1) with many dark brown spots; veins near spots, especially vein R_{2+3} , sinuous, apex of vein R_{2+3} meeting C at nearly right angle; crossvein dm-cu conspicuous; costal vein index 0.70; M vein index 0.71. Halter yellow. Legs yellow except mid- and hindcoxae and tarsomere 5 dark brown.

Abdomen: Subshiny black with thin brownish-yellow microtomentum. 5th sternite of male deeply U-shaped. Male genitalia (Figs. 2–5). Epandrium in posterior view tapered medioventrally, bearing several strong setae medially including around cercal cavity and toward ventral

margin (Fig. 2), in lateral view (Fig. 3) curved, sinuous; hypandrium in lateral view (Fig. 5) with a subapical, lateral projection; aedeagus in lateral view (Fig. 5) irregularly spoon-shaped, asymmetrically furcate basally, forming narrowly excavate sub-basal gap with a short, pointed projection near middle at end of gap and along longer extension; phallopodeme narrowly wedge-shaped in ventral view (Fig. 4); hypandrium (Fig. 5) greatly enlarged, wide, especially basally, with a medial, triangular-shaped keel subapically.

Female: Body length: 2.00 mm; wing length: 2.30 mm. Ventral receptacle round, with convex round cap at apex, and with wide tail at base (Fig. 6).

Type material.—Holotype male: CHINA. *Fujian*: Longqishan, Yujiaping (26°44'N, 117°28'E), 26.VIII.2006, Xian Zhou. The holotype is deposited in CAU. One female paratype: CHINA. *Yunnan*: Mengyang, Yexianggu (21°04'N, 100°53'E), 5.IV.1999, Ding Yang (CAU). Other paratypes are as follows: JAPAN. *Honshu*: Ibaraki Prefecture, Tsuchiura (36°05'N, 140°12'E; marsh; Malaise trap), 12 Jul–6 Sep 1989, M. J. Sharkey (11 ♂, 4 ♀; USNM).

Distribution.—Oriental: China (Fujian, Yunnan). Palearctic: Japan (Honshu).

Etymology.—The specific epithet, *maculosus*, refers to the spotted wing.

Remarks.—This new species is somewhat similar to *Z. invenatus* (Lamb) from the Oriental and Palearctic Regions in wing markings but can be distinguished from the latter by the brownish-yellow face, the presence of crossvein dm-cu, and the yellow forecoxa. In *Z. invenatus*, the face is reddish, crossvein dm-cu is absent, and the forecoxa is nearly black (Cresson 1943).

Zeros orientalis Miyagi
(Figs. 7–12)

Zeros orientalis Miyagi 1977: 60 [Japan. Ryukyu Islands: Okinawa, Nago

(26°35.5'N, 127°58.6'E); HT ♀; HUS].—Morimoto 1989: 823 [checklist, Japan].—Mathis and Zatwarnicki 1995: 190 [world catalog].

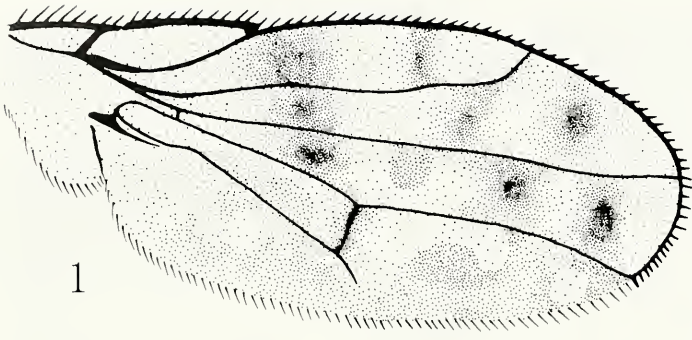
Diagnosis.—Wing with few dark brown spots; veins straight. Epandrium parallel-sided in posterior view, with 4 strong setae at anterior end; hypandrium without projection in lateral view; aedeagus C-shaped in lateral view.

Description.—Male. Body length 1.65 mm, wing length 1.70 mm.

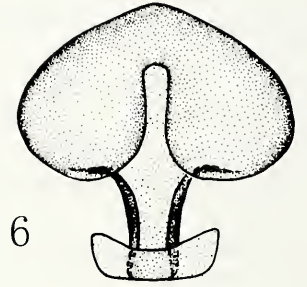
Head: Brown; frons brownish yellow with thin brownish-yellow microtomentum. 2 vertical setae; 2 fronto-orbital setae, anterior fronto-orbital seta proclinate, posterior fronto-orbital reclinate, reclinate fronto-orbital seta stronger than proclinate fronto-orbital seta; 1 pair of strong ocellar setae. Face black with grayish white microtomentum; face with 3 strong setae on each side. Gena with 1 strong seta. Antenna brownish yellow except antennal segment III yellow ventrally. Pedicel with 3 dorsal setae; arista with 7–8 dorsal rays.

Thorax: Subshiny black; mesonotum, notopleuron and anepisternum with brownish-yellow microtomentum; katepisternum with yellowish-gray microtomentum. 1 presutural supra-alar seta; 2 strong dorsocentral setae; 2 rows of small acrostichal setulae; 1 strong prescutellar seta; 2 notopleural setae; 2 strong supra-alar setae. Anepisternum with 3 strong setae at posterior margin; katepisternum with 1 strong seta. Scutellum brownish-yellow microtomentose, with 2 pairs of scutellar setae. Wing (Fig. 7) with a few, moderately short, dark brown, transverse bars rather than spots; veins straight; crossvein dm-cu conspicuous; costal vein index 0.88; M vein index 0.53. Halter yellow. Legs yellow except mid- and hindcoxae brown and tarsomere 5 brownish yellow.

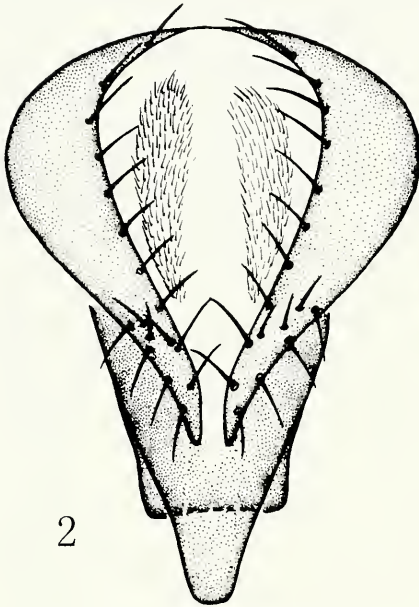
Abdomen: Brown. Male genitalia (Figs. 8–11): Epandrium in posterior



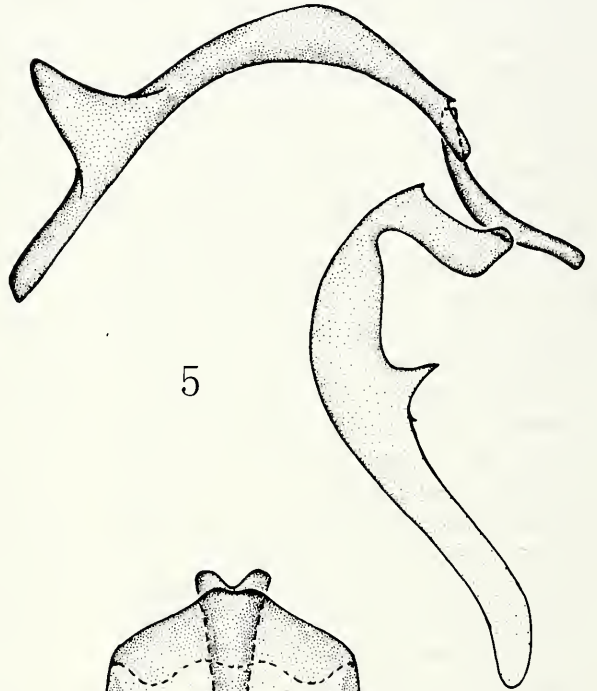
1



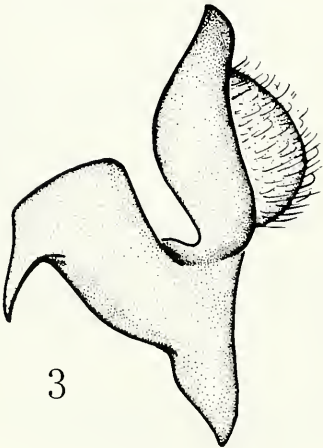
6



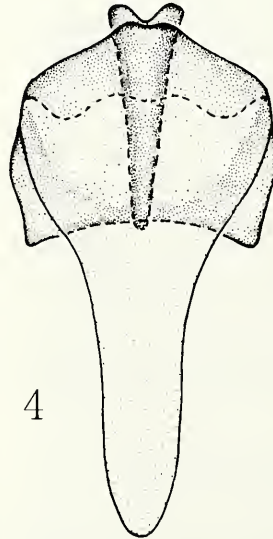
2



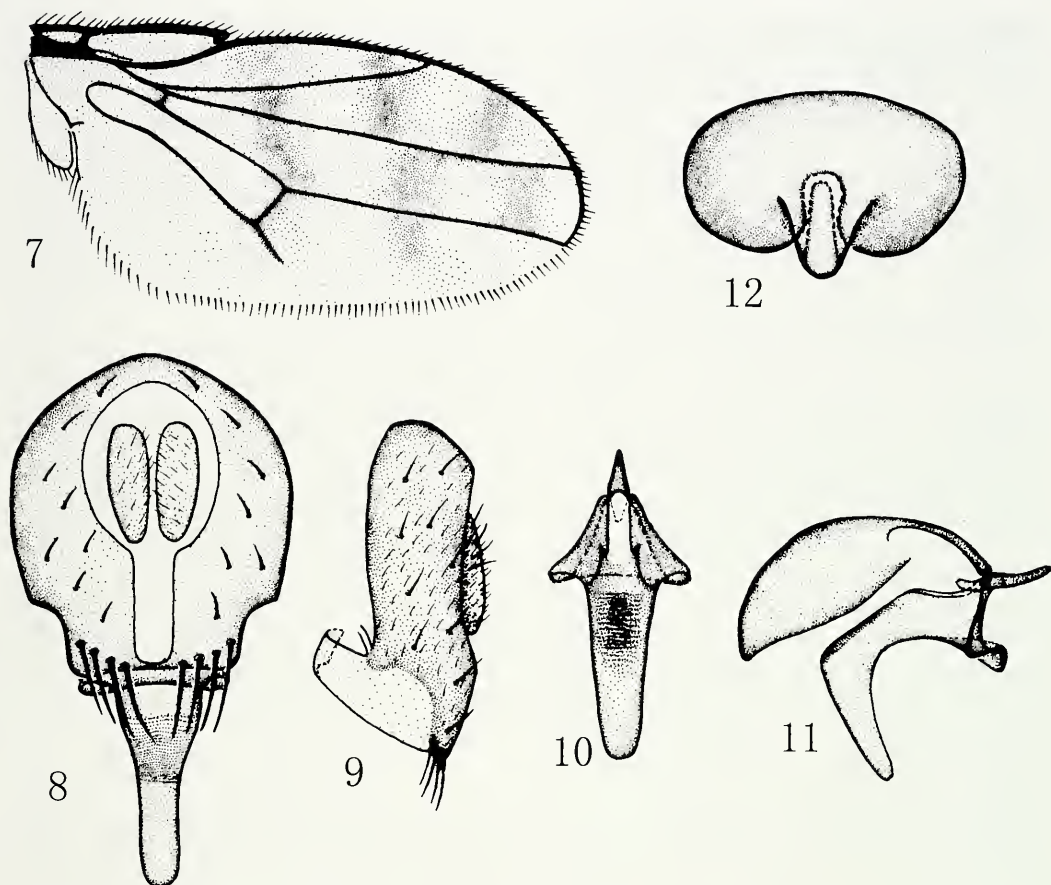
5



3



4



Figs. 7-12. *Zeros orientalis*. 7-12, Male. 7, Wing. 8, Epandrium, cercus and aedeagus, posterior view. 9, Epandrium and cercus, lateral view. 10, Aedeagus and phallapodeme, ventral view. 11, Hypandrium, aedeagus and phallapodeme, lateral view. 12, Female, ventral receptacle.

view (Fig. 8) almost parallel-sided over medial portion, thereafter sharply narrowed steplike, ventral margin nearly truncate, bearing 4 strong setae on each side, setae oriented ventrally, in lateral view (Fig. 9) nearly straight vertically; hypandrium in lateral view (Fig. 11) pouch or pocket-like without lateral projection; aedeagus in lateral view (Fig. 11) angulate U-shaped, inner emar-

gination deeply rounded, in ventral view (Fig. 10) triangular on basal 1/3, thereafter apically digitiform, only slightly tapered; phallapodeme reduced, bar-like in lateral view (Fig. 11), in ventral view (Fig. 10) sharply pointed.

Female: Body length 1.75 mm; wing length 2.15 mm. Ventral receptacle approximately round, with slender tail at base (Fig. 12).

←

Figs. 1-6. *Zeros maculosus*. 1-5, Male. 1, Wing. 2, Epandrium, cercus and hypandrium, posterior view. 3, Epandrium and cercus, lateral view. 4, Aedeagus and phallapodeme, ventral view. 5, Hypandrium, aedeagus and phallapodeme, lateral view. 6, Female, ventral receptacle.

Specimens examined.—CHINA. *Guangxi*: Maoershan, Tongrencun (25°53'N, 110°25'E), 2 May 2004, Ding Yang (1♂; CAU); Maoershan, Tongrencun (25°53'N, 110°25'E), 2 May 2004, Yanling Xu (1♀; CAU). *Henan*: Anyang, Linzhou, Shibanyan (36°06'N, 114°21'E), 23 Jul 2006, Junhua Zhang (3♂; CAU).

INDIA. *Assam*: Chabua (27°29'N, 95°11'E), 9 Jan 1944, D. E. Hardy (1♂; USNM); Digboi (27°23'N, 95°38'E), 30 Mar 1944, D. E. Hardy (1♀; USNM); Duamara (NE Doom Dooma; 27°34'N, 95°34'E), 2 Dec 1943, D. E. Hardy (2♂, 2♀; USNM); Misamari (35 mi NW Tezpur; 26°48'N, 92°36'E), 29 Jan 1944, D. E. Hardy (1♂, 1♀; USNM); Rupsi (15 mi NW Dhubri; 26°08'N, 89°56'E), 3 Nov 1943, D. E. Hardy (2♂, 4♀; USNM); Sadiya (27°50'N, 95°40'E), 13 Feb 1944, D. E. Hardy (3♂, 4♀; USNM); Tinsukia (6 mi N; 27°30'N, 95°22'E), 26 Mar 1944, D. E. Hardy (7♂, 5♀; USNM). *Bengal*: Kolkata (Botanical Garden; 22°32'N, 88°20'E), 4 Nov 2002, A. Freidberg (1♀; USNM). *Karnataka*: Mudigere (19 km W; 13°08'N, 75°26'E), 6 Apr 1980, A. Freidberg, W. N. Mathis (3♀; USNM); Mudigere (24 km W; 13°07.8'N, 75°24'E), 7 Apr 1980, A. Freidberg, W. N. Mathis (1♂; USNM); Mudigere (27 km NW; 13°10'N, 75°25'E), 6 Apr 1980, A. Freidberg, W. N. Mathis (1♀; USNM); Mudigere (13°07.8'N, 75°37.8'E), 6–7 Apr 1980, A. Freidberg, W. N. Mathis (1♂, 1♀; USNM). *Rajasthan*: Bap Lake, near Phalodi (Rt. 15; 27°07.8'N, 72°22.2'E), 19 Nov 2002, A. Freidberg (2♀; USNM); Nagda Temple (25 km N Udaipur; Lake; 24°34.8'N, 73°41.4'E), 22 Nov 2002, A. Freidberg (3♀; USNM).

JAPAN. *Honshu*: Ibaraki Prefecture, Tsuchiura (36°05'N, 140°12'E; marsh; Malaise trap), 24 Jul–6 Sep 1989, M. J. Sharkey (1♂, 1♀; USNM).

NEPAL. *Chitwan*: Dhungari Khola (2 km E; 27°30'N, 84°20'E), 1 Nov 1985, W. N. Mathis (1♀; USNM).

Distribution.—Oriental: China (Guangxi); India (Assam, Bengal, Karnataka, Rajasthan), Japan (Ryukyu Islands), Nepal (Chitwan). Palearctic: China (Henan); Japan (Honshu, Shikoku).

Remarks.—Until now, this species was known only from Japan, and the records noted here from China, India, and Nepal are the first for their respective countries on mainland Asia.

This species is similar to *Z. defectus* (Malloch) but differs from it in structures of the male terminalia, especially the ventral margin of the epandrium (fused surstyli), which is essentially truncate, bearing 4–5 large setae, and the acutely curved aedeagus (somewhat angulate around outer curvature). Our comparison with *Z. defectus* is based on specimens from Queensland, Australia, near the type locality of the female holotype of *Z. defectus*.

ACKNOWLEDGMENTS

We are very grateful to Ms. Yanling Xu and Xian Zhou (Beijing) for collecting some of the specimens. This research is supported by the National Natural Science Foundation of China (No. 30225009). We also express thanks to Philip J. Clausen (University of Minnesota), Joe E. Keiper (Cleveland Museum of Natural History), and Allen L. Norrbom (USDA, Systematic Entomology Laboratory) for their reviews of the manuscript.

LITERATURE CITED

- Cogan, B. H. 1984. Family Ephydriidae, pp. 126–176. In Soós, Á. and L. Papp, eds. Catalogue of Palearctic Diptera 10. Elsevier Science Publishers, Amsterdam; and Akadémiai Kiadó, Budapest. 402 pp.
- Cogan, B. H. and W. W. Wirth. 1977. Family Ephydriidae, pp. 321–339. In Delfinado, M. D. and D. E. Hardy, eds. A catalogue of the Diptera of the Oriental Region. Volume III. Suborder Cyclorrhapha (excluding Division Aschiza). University Press of Hawaii, Honolulu. 451 + vii pp.

- Cresson, E. T. Jr. 1943. The species of the tribe Ilytheini (Diptera: Ephydriidae: Notiphilinae). Transactions of the American Entomological Society 69: 1–16.
- Foote, B. A. 2007. Biology of *Ilythea caniceps*, *I. spilota*, and *Zeros flavipes* (Diptera: Ephydriidae), case-making consumers of diatoms on shorelines. Proceedings of the Entomological Society of Washington 109: 125–130.
- Hollmann-Schirmacher, V. 1998. Phylogeny of the subfamily Ilytheinae (Diptera, Ephydriidae) with special reference to the genus *Philygria*. Studia Dipterologica Supplement 5: 1–144.
- Mathis, W. N. 1986. Studies of Psilopinae (Diptera: Ephydriidae), I: A revision of the shore fly genus *Placopsidella* Kertész. Smithsonian Contributions to Zoology 430: 1–30 + iv pp.
- Mathis, W. N. and T. Zatwarnicki. 1990a. A revision of the western Palearctic species of *Athyroglossa* (Diptera: Ephydriidae). Transactions of the American Entomological Society 116(1): 103–133.
- . 1990b. Taxonomic notes on Ephydriidae (Diptera). Proceedings of the Biological Society of Washington 103(4): 891–906.
- . 1995. A world catalog of the shore flies (Diptera: Ephydriidae). Memoirs on Entomology, International 4: 1–423.
- McAlpine, J. F. 1981. Morphology and Terminology—Adults, pp. 9–63. In McAlpine, J. F., et al., eds. Manual of Nearctic Diptera, Ottawa, [Vol. 1 is Monograph 27 of Research Branch Agriculture Canada.]
- Miyagi, I. 1977. Ephydriidae (Insecta: Diptera). In, Fauna Japonica. Keigaku Publishing Company, Limited, Tokyo. 113 pp.
- Morimoto, K. 1989. Diptera, pp. 699–874. In Hiraschim, Y. ed. A check list of Japanese insects. 2. Entomological Laboratory, Faculty of Agriculture, Kyushu University and Japan Wildlife Research Center. Issuido Printing Company, Fukuoka. 1088 pp. [In Japanese.]